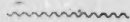


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James Fletcher.

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CENTRAL EXPERIMENTAL FARM



REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, F.R.S.C., F.L.S.)

FOR 1892.

REPORT OF THE ENTOMOLOGIST AND BOTANIST.

(JAMES FLETCHER, F.R.S.C., F.L.S.)

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Director, Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report upon some of the more important subjects which have been brought under my notice officially during the past season. The only new insect pest of importance which requires special mention here is the Cattle Horn-fly (*Hæmatobia serrata*, R. Desv.), upon which under your instructions I prepared a bulletin (C. E. F. No. 14) in September last. This has been distributed to our correspondents both in English and French, and I trust that the farmers of Canada will recognize the great importance of using every effort to stamp out this small but formidable foe. Enquiries concerning insects, for the most part this year, have been with regard to enemies of field and fruit crops. In the division of Botany, some interesting experiments have been carried out as to the best means of preventing loss from the disease, known as Potato-rot. The collection in the Botanic Garden has been increased by about fifty species, chiefly willows, poplars, oaks and birches. A border for perennials has also been begun, and clumps of about forty of our native Michaelmas-daisies, golden-rods and other plants have been established. Large numbers of specimens have, as usual, been sent in for identification, both of insects and plants.

Field Crops.—Cereal crops have on the whole been somewhat freer from insect attacks than usual. The Hessian Fly and the Wheat-stem Maggot were sent in from a few localities. In the Ottawa district the former was sought for carefully, but in vain. Last year, through the kindness of Professors Riley and Forbes, I was favoured with a consignment of Hessian Fly "flax seeds" infested by a parasite which has done good service in Europe by reducing the numbers of this often undetected foe. These arrived in good condition, and were liberated at Ottawa in a field known to be infested. Although no specimens could be found of the parasite or its host, I am still hopeful that the parasite may have established itself, and that the benefit of the experiment may become evident later. The strange injury to oats by the common Red-legged Locust (*Melanoplus femur-rubrum*, De G.), which has been frequently noted, in which the flowers and grains are cut off from the panicles and dropped to the ground, has been again reported by the Hon. G. W. Allan, from his farm near Barrie, Ont. Grain crops were somewhat injured in eastern Ontario by the Devastating Cut-worm (*Hadena devastatrix*, Brace). Corn was less attacked, as far as I have received reports, than for many years previously. The only cut-worm that was sent in frequently was the Red-backed Cut-worm [*Agrotis (Carneades) ochrogaster*, Guen]. I was able to clear up part of the life history of this species during the past season. Eggs laid by a female caught in the field during October, 1891, hatched only on April the 20th following. These were full grown, and pupated June 10th, the first moths appeared July 20th. This is a large caterpillar, exceeding $1\frac{1}{2}$ inches in length when full grown, and attacks almost all succulent vegetation.

The Pea-weevil has been unusually destructive, and were it not that there was a larger acreage than usual put in to this crop, there would have been a considerable shortage in Ontario. Bean plants in most districts were severely injured by Anthracnose [*Colletotrichum Lindemuthianum* (Saccardo and Magnus) Brios. and Cava.], and experiments were carried out by Mr. Craig on the beans grown in the horticultural

department, with a view of discovering a remedy. These will be found in his report on page 104.

Root maggots of cabbages, onions, radishes and turnips have been, perhaps, the most troublesome pests of the year. For garden application Hellebore tea and Kerosene Emulsion applied at the roots have been successful, but for field practice no adequate remedy has so far been discovered.

The Colorado Potato-beetle (*Doryphora 10-lineata*, Say) made its appearance as a serious pest of potatoes in Nova Scotia and Prince Edward Island. Paris Green is undoubtedly the best remedy for this enemy, and, when it is used with proper care, no danger of poisoning need be apprehended. It is poisonous, of course, very poisonous; but so are many other substances which it is necessary to use. No possible ill results to human beings can follow its use upon plants, from their absorbing its poisonous principles into their tissues. A predaceous bug (*Podisus cynicus*, Say), which was found feeding upon the Colorado Potato-beetle, by Mr. A. J. McNeill, of Little Sand's, P.E.I., was also sent to me by correspondents at London, Toronto and Ottawa.

Turnips were comparatively little injured by the Flea-beetle; but late in September the Turnip Aphis (*Aphis rape*, Curtis) made its appearance in a few localities in alarming numbers; specimens were received from Prince Edward Island, Quebec and Eastern Ontario. Turnips on the Central Experimental Farm were brought to me on the 4th of November, which had been heavily infested, but the pests had been entirely destroyed by the fungus *Empusa aphidis*, Hoffm., the whitened and swollen dead bodies being in conspicuous masses at the bases of the leaves.

The Zebra caterpillar of *Mamestra picta*, Harr., was very numerous in the vicinity of Ottawa. It appears to be literally omnivorous, attacking plants of all orders. It was very destructive to young spruces, asparagus and peas, cabbages, clovers, etc., and was sent in several times as an enemy of potatoes. Late in the season, as recorded further on, the eggs were largely destroyed by parasites.

The Celery caterpillar, *Papilio Asterias*, Fabr., was sent in from various places in Ontario and Quebec, where it was destructively abundant upon celery, carrots and parsnips. Of those bred, most of the specimens were found to be parasitised by the Ichneumon fly *Tropus exesorius*, Brullé.

A caterpillar which occurred in undue numbers all through the eastern portions of the Dominion was the so-called "Salt-marsh Caterpillar" (*Leucarcia aceræa*, Dru.) This insect is widely distributed and occurs all over Canada. The caterpillars, known as "Woolly Bears," feed upon most low plants, and are occasionally, when abundant, injurious in gardens to beans, lettuce, cabbage, etc.; but their favourite food plants seem to be useless weeds, such as lamb's quarters, dandelion, etc. A consignment of caterpillars sent to me by Mr. C. H. Wright, of Middleton, Ont., was found to be infested with the infectious fungous disease *Empusa grylli*, Fres., var. *aulicæ*. Experiments made with the object of propagating this disease apparently failed.

Fodder Crops.—Hay and all fodder crops were excellent in most of the provinces, the spring having been exceptionally favourable. Grass insects received some attention. The injury known as "silver top" was remarkably prevalent, and is due to several insects, principally, I think, as suggested by Prof. Osborn, to small leaf-hoppers, perhaps also to a Thrips, and also in the stems of some of the larger grasses to the Wheat-stem Maggot. In the experimental grass plots, the larva of *Hydræcia cataphracta*, Grote, the Tomato-stem Borer, was very abundant in the young stems of *Phalaris arundinacea* and *Elymus Canadensis*. The same caterpillar was also more than usually destructive, burrowing in the stems of many herbaceous plants, such as tomatoes, potatoes, lilies, sunflowers, &c. There was doubtless much unrecognized injury to grass lands from the attacks of the Devastating Cut-worm and the American Frit-fly underground, and a true Thrips upon the leaves. A severe attack upon marsh grass lands by an insect which has never before, in my experience, been noticeably, injurious, was that of *Otenucha Virginica*, Charrp., which was reported to me by Mr. Amos Vernon, of Minudie, N.S. The caterpillars are interesting, from their very different colouration during the last moult, when they are

yellowish white, and the preceding ones, when they are black and white, with yellow ornamentation.

Fruit Crops.—There has been as usual much inquiry with regard to the common pests of the orchard and garden, such as the Tent Caterpillars, the Oyster-shell Bark-louse, the Red-humped Caterpillar of the Apple, the Woolly Aphis, the Grape-vine Leaf-hopper, and the Cherry-slug.

The Eye-spotted Bud-moth did not occur nearly so widely nor so abundantly as last season. The Cigar Case-bearer, mentioned in my report for 1891, at page 196, has been named by Prof. Fernald, of Amherst, Mass., *Coleophora Fletcherella*. This insect which was first sent some year ago from Prince Edward Island and New Brunswick, appeared in enormous numbers in 1891 in the orchard of Dr. D. Young, at Adolphustown, Ont. Dr. Young has carried out careful spraying experiments both with hot and cold Kerosene Emulsions and different strengths of Paris Green. He has found this a difficult pest to eradicate, but has succeeded best with the Kerosene Emulsion used in spring when the caterpillars are active. An outbreak of the Apple Bucculatrix at St. Catharines, Ont., was kindly brought to my notice by Mr. W. J. Hambly, of the Toronto Mail, and specimens of twigs from infested trees, which has been sent to me, without any letter, show that the insect occurred in very great numbers. From specimens received, coming from widely separated districts, I fear that the Pear-leaf Blistar is spreading. The almost invisible elongated white mites which cause the blisters on the leaves, pass the winter in the scales of the buds of pear-trees. The best remedy is to spray infested trees, just as the buds are opening, with Kerosene Emulsion.

A new attack of some interest upon apple buds and blossoms is reported from Nova Scotia by Col. W. M. Blair, Superintendent of the Experimental Farm, at Nappan, N.S. This is by the cleek-beetle, *Corymbites caricinus*, Germ. I have, on two occasions previously, received these beetles from Nova Scotia as occurring upon apple blossoms, but with no statement as to their injuries. Col. Blair, however, writes to me on the 1st of June: "I send you herewith some beetles which are destroying the foliage of our trees. They are on every tree in hundreds and seem to suck the leaves as soon as they appear. They fall to the ground at the slightest shake. When the flowers open, they attack those also, and many other plants and shrubs, in fact, they are on almost everything that has a leaf." Prompt spraying with Paris Green was recommended and the collection of the beetles by beating the foliage over a beating-net or an inverted umbrella.

The enemies of the grape-vine were abundant in western Ontario, but their attacks were most noticeable upon the Virginian Creeper (*Ampelopsis quinquefolia*). The caterpillars of the Beautiful Wood-nymph and the Lesser Grape-vine Sphinx in many places, stripped this ornamental creeper of its foliage; both, however, were much reduced in number by parasites.

The Raspberry-cane Girdler (*Obera bimaculata*, Oliv.) was the chief enemy of the raspberry in the Ottawa district, and specimens of its work came in from other parts of Ontario and Quebec.

Paria sex-notata was again this year a most serious pest of raspberries at St. Catharines, Ont. Mr. Martin Burrell writes; "My old enemy *P. sex-notata* has revisited me this spring in greater numbers than ever. I sprayed with Paris Green, 4 ounces to 40 gallons, but the foe still 'bobbed up serenely.' Of a quarter of an acre of my raspberries not a score of canes have leafed out. I am not the only victim this year, as several of my neighbours have been seriously injured by the beetles." This insect, like the Rose-beetle (*Macrodactylus subspinosus*, Fabr.), appears to be very difficult to treat, even Paris Green having much less effect than much milder poisons with other insects. It is the perfect insects which destroy the young growth at the time of flowering. The grub passes its life under ground, living upon roots.

Red and white currants, were neglected, have been defoliated by the Imported Currant Saw-fly. Paris Green early in the season and White Hellebore after the fruit has formed are safe and effective remedies. Fruit infested by the Currant Weevil (*Anthonomus rubidus*, Lec.) was sent by Mr. W. S. Duggan, from Murray Bay, Que.,

where it had reduced largely his crop of red currants. This weevil can generally be found every year at Ottawa in small numbers but nearly always in white currants. All infested fruit ripens before the main crop and should be destroyed before it drops from the branches.

Forest Trees.—The most noticeable attack of this year to forest trees was by the Fall Web-worm (*Hyphantria cunea*, Dru), and where the webs were not removed upon their first appearance in August, at which time it would have been and easy matter, the disgusting webs filled with excrement, remain as unsightly witnesses of negligence. *Lophyrus abietis*, Harr, the Spruce Saw-fly, attacked Norway spruces in Winnipeg and western Ontario. It was also injuriously abundant upon native spruces in the Muskoka district. The Larch Saw-fly, *Nematus Erichsonii*, Hart., continues its ravages in the tamarack swamps of Ontario, Quebec and the Maritime Provinces. Already thousands of acres of native larch have been killed. Two other imported saw-flies are now being studied at Ottawa, where they have developed during the last four years as serious pests. *Pezusa varipes*, St. Farg. (*melanopoda* Cam.) and *Nematus pallidiventris*, Fallen. The former of these is a small black saw-fly, $\frac{1}{2}$ of an inch in length or a little more, which inserts its eggs beneath the epidermis of the upper surface of the young leaves of the European alder. The larvæ mine within the leaves and give them a very blotched and withered appearance. When full-grown, they eat their way out and fall to the ground, beneath the surface of which they pass the pupal stage. There are two and perhaps three broods in the season. So far no parasites have been detected. Owing to their habit of feeding within the leaves a practical remedy is difficult to devise. *Nematus pallidiventris* is a species found in Northern Europe and was probably introduced with willows from Russia. In all its stages it somewhat resembles the Imported Currant Saw-fly and is easily checked by spraying with Paris Green.

Weeds.—There has been much correspondence on this important subject, of which I treated at some length in my last report. The most serious imported agricultural pest is a member of the Mustard family. *Sisymbrium sinapistrum*, the "Tumbling Weed" of the settlers around Indian Head, N.W.T. This is a large coarse annual or biennial, according to locality. In Europe, where it is native, it is according to D. Rapin, an annual in the valley of the Rhône, and, according to Dr. M. Seubert, a biennial in the valley of the Rhine. The same difference exists in Canada; a plant observed on a railway bank at Ottawa passed the winter and threw up its flowering spike in June. In the North-west, however, it is a true annual. Mr. Mackay writes: "It starts in the spring from seed, and if let alone, will ripen its seed at the same time as mustard, or about wheat harvest. If cut off above the ground, it will throw out shoots, which, if let alone, will ripen seed before frost comes, if the first cutting is early enough. If not, the shoots will go on growing until the first frost destroys it. It does not start in the spring from the autumn growth, as you suggest, for that is entirely dead. One seed produces one stock which lives and dies the same season." The normal size of this plant in Europe is about two feet high, but a large specimen sent to me entire by Mr. Mackay for the purpose of counting the seeds was more than twice that height, with numerous branches covered with long pods. All of these were counted: each pod contained an average of 120 seeds in two ranks and gave the enormous total of one and a half millions of seeds from the one plant. These when threshed out weighed 150 grammes (nearly 5½ ounces.) The seeds are very small, about half the size of the seed of timothy, and dark reddish brown in colour. There is no doubt but the introduction of this pernicious weed into the North-west Territories is a most serious matter, and it is gratifying to know that farmers there are paying so much attention to this subject and using every effort to stamp out noxious weeds. The large number of specimens which have been sent to me for identification by farmers, weed inspectors and others, are proof of this.

Of plants which have developed locally as aggressive weeds, in addition to the above, the following may be mentioned, and tend to show that almost any plant under special circumstances may become a troublesome pest: *Camelina sativa*, *Neslia paniculata*, *Iva xanthiifolia*, *Iva axillaris*, and *Corydalis aurea* in Manitoba;

Cuscuta trifolii, from Ashcroft, B.C., and from western Ontario, *Hieracium aurantiacum*, extending from the Eastern Townships into Vermont, and *Lepidium campestris*, from Stoney Creek, Ont.

The subject of "Loec" weeds has been brought forward by the poisoning of sheep and lambs in Manitoba, but no specimens were forwarded, and nothing definite was ascertained. It would be well if the owners of sheep runs would send specimens of any plants belonging to the Pea family with upright (not creeping) stems which they may find on the runs, when sheep have been poisoned.

Meetings.—I have during the year attended five Farmers' Institute meetings, at Cowansville, Que., Brantford, Picton, Carp and Galetta, Ont. At the request of the Hon. Minister of Agriculture and Arts of Ontario, I attended a meeting of a committee of the Provincial Legislature, and gave evidence as to the best time to spray fruit trees to destroy insect pests, without running the risk of poisoning bees, which are of so much importance to fruit-growers in fertilizing blossoms, as also of course in making honey.

Acknowledgments.—I beg again to express my thanks to many who have rendered me valuable assistance in making observations and sending me prompt notice of the occurrence of injurious insects and fungous pests. I wish particularly to acknowledge my indebtedness to Prof. C. V. Riley, Dr. George Vasey, and Mr. B. T. Gallo-way, of Washington, and Prof. John Macoun, of Ottawa, for many favours in the identification of specimens and for the loan of illustrations; also to Dr. J. Hamilton, of Allegheny, Pa., for the identification of coleoptera, and Prof. Byron D. Halsted, of New Brunswick, N.J., of fungi.

Donations have been received from the following:—

- Prof. John Macoun, seeds of native plants.
- T. N. Willing, Calgary, N.W.T., seeds of native plants.
- W. E. Saunders, London, Ont., specimens of native plants.
- W. Scott, Ottawa, specimens of native plants.
- J. Dearness, London, Ont., specimens of native plants.
- Dr. J. E. White, Toronto, collection of roots of native plants.
- J. R. Anderson, Victoria, B.C., collection of roots of native plants.
- Prof. W. J. Beal, Agricultural College, Mich., grass seeds.
- J. S. Pearce & Co., London, Ont., grass seeds.
- Sutton & Sons, Reading, England, grass seeds.
- Vilmorin, Andrieux & Co., Paris, France, clover seeds.
- Hon. C. F. Cornwall, Ashcroft, B.C., roots of *Lewisia rediviva*.
- J. B. Olcott, South Manchester, Conn., fine sod of *Festuca*, Olcott No. 1.
- W. H. Holland, Norquay, Man., root of *Physalis grandiflora*.
- Pro. H. Garman, Lexington, Ky., seed of Kentucky grown *Poa pratensis*.
- R. E. Purver, Riverside, B.C., specimens of insects.

On April 11, Mr. J. A. Guignard, B.A. and B.L., B. Sc., of the University of France, was appointed Assistant Entomologist and Botanist, and with his valuable assistance, I am gradually clearing off the large amount of back work which had accumulated during the past four years. Mr. Guignard's knowledge of European languages, added to his scientific attainments, has rendered his appointment one of much value in the successful conduct of my department.

I have the honour to be, sir,

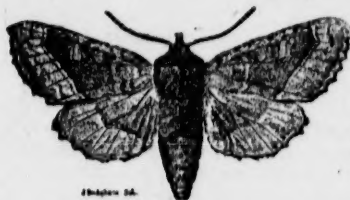
Your obedient servant,

JAMES FLETCHER,

Entomologist and Botanist.

DIVISION OF ENTOMOLOGY.

THE HOP-VINE BORER, "THE COLLAR-WORM OF THE HOP."

(Hydræcia immanis, Guen.)Fig. 13 The Hop-vine Borer. *Hydræcia immanis*.

the root stock. The larvæ are, when full grown, large fat caterpillars, $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in length, of a dirty white colour, with reddish-brown heads and having the body spotted with black bristle-bearing tubercles. The dark bands which were conspicuous in the young larvæ are now almost obliterated and quite so in some specimens.

In June, 1889, my attention was drawn to this insect by Mr. Wellington Boulter, of Picton, Ont.; and from several hop growers, I learnt that the ravages in some sections of Prince Edward County were considerable every year. Since that time and with the assistance of Mr. S. J. Cotter, Secretary-Treasurer of the Dominion Hop-Growers' Association, I have worked out the life history of this pest.

The first notice I find in literature of the Hop-vine Borer is by Dr. Bethune, in the Report of the Entomological Society of Ontario for 1872, page 33, where a detailed description is given of some larvæ which were found injuring hops by gnawing the stems at the crown. Canadian entomologists have from time to time tried to identify that insect. I have now no doubt that the larvæ described were of *H. immanis*. In the *Canadian Entomologist*, vol. XIV, 1882, p. 93, is an interesting article by C. R. Dodge, entitled "The Hope-vine Borer," in which the author describes correctly the habits of the larvæ and gives much valuable information with regard to the injuries committed by them. Mr. Dodge does not give the name, but unhesitatingly pronounces it to be identical with those described by Dr. Bethune. Dr. Lintner in his Second Report, 1885, p. 41, says of this insect; "Our first knowledge of its true character was that obtained from Prof. J. H. Comstock, who at the annual meeting of the Entomological Society of Ontario, held at Montreal during the meeting of the American Association for the Advancement of Science, in August, 1882, exhibited several examples of the insect, which he had succeeded in breeding from the 'Hop-grub.' We know of no publication by Prof. Comstock of his study of this insect."

In Bulletin 4, Division of Entomology, Prof. J. B. Smith, published an extensive report of some observations made by him in New York State, under the direction of the Entomological Division of the United States Department of Agriculture.

Prof. Lintner in his article above referred to, which appeared in 1885, reproduces the salient points of previous records, and also adds some further notes of interest.

The ravages of this insect have been long known to hop growers in New York and New Jersey States, as well as the main features of its life history.

It is, however, by no means a common insect in Canada. The moth occurs rarely at Ottawa, and I have specimens from Toronto and London, Ont. The larvæ are described by Dr. Bethune as occurring in large numbers at Erindale, Credit, Ont. In Prince Edward County, where the cultivation of the hop has become an important industry, this enemy has been allowed to increase so much that it is now a serious drawback to the lucrative cultivation of the hop.

"August 4th.—I enclose you some objects which I find down in the ground in my hop hills. What are they, and what will they bring forth? The grubs in my hop-yard are very numerous, and doing a great deal of damage. Please give any information you can."—JAMES CRAWFORD, Bethel, Ct.

The objects sent by Mr. Crawford were the chrysalides of *H. immanis*, from which I bred some moths, and one specimen of *Ichneumon jucundus*, Brullé.

Life-history.—The eggs are greenish white, rounded above, flattened beneath, finely striate from the apex to the base. They are laid singly on the young shoots of the hop as soon as they appear above the ground. The growth of the shoots is very rapid at this time of the year, and they are about 3 feet high before the work of the young caterpillars is noticed.

The young caterpillars are very slender, pale in colour, with dark longitudinal lines, and dotted with black bristle-bearing tubercles. They at once eat their way into the vine and stop its growth, causing what are known as "bull-heads," among the hop growers of Prince Edward County, but "muffle-heads" in New York State, according to Prof. Smith. The cause of these bull-heads is, the central shoot being destroyed, growth is checked for a time, but two shoots are produced from the joint next below the injury. When the caterpillar is about half an inch in length it eats its way out of the shoot and lets itself down to the ground, and Prof. Smith states, "entering the stem at the surface of the soil feeds upwards, interrupting the growth of the vine and lessening its vitality. The larva now changes colour, and becomes dirty white with a strong deep reddish tint, apparently proceeding from beneath the surface of the skin, and with numerous black spots. As the vine grows, it becomes hollow and hardens, and the more rapidly as the free flow of sap is interrupted. The larva, now about an inch in length, and still slender, burrows downward to the base of the vine at its junction with the old stock, and eating its way out completes its growth as a subterranean worker. It is in this state that it is best and most widely known as the hop 'grub,' and the ravages caused by it are the most noted." (U. S. Div. of Ent., Bul. 4, p. 35.)

According to Mr. Cotter's observations, the young caterpillars for the most part, leave the tips of the vines before the end of May, but occasional specimens may be found in the tips, even to the middle of June. They become full grown by the first week in August, so that for two months these larvæ are a constant drain on the vitality of infested plants. The injury to the stems by the large caterpillars is apparently, in comparison with their size, small. A wound is eaten into the side of the stem; the caterpillar lies in the ground close to this, and must, I judge, subsist almost entirely upon the sap. When full fed it assumes the chrysalis form in the ground close to the roots of the hop plants. This is from 1 to 1½ inches in length, dark brown in colour, elongated and heavy in shape, with a double spine at the blunt posterior end. It remains in the chrysalis condition from five to seven weeks, and the moths are found on the wing during September and October. They pass the winter in a torpid state, probably beneath leaves and rubbish. Several specimens kept alive in a breeding cage remained constantly on the bottom and took advantage of any small object to hide beneath it. The moth itself, although very inconspicuous when on the ground or among leaves, is a beautiful creature when examined closely, from the contrast of the shades of colour and the velvety appearance of the central area of the wings. The moth measure 1½ to 2½ inches across the expanded wings. The general colour is a rosy brown, which is paler at the extremities of the wings; the central portion is much darker, being shaded with dark velvety bronze, and is marked with two large pale spots known as the orbicular and reniform. The fore wings are divided into three areas by narrow, oblique, transverse lines, edged exteriorly with pale pink. The hind wings are paler in colour, crossed in the middle by a slightly darker line. The sexes are similarly marked, but can be distinguished by the larger abdomen of the female and a conspicuous fan-shaped brush at the extremity of the abdomen of the male.

This moth has been placed in the three different genera, *Gortyna*, *Apamea* and *Hydræcia*, by different writers. Prof. Riley writes me lately: "As regards *immanis*,

I think that we should follow Prof. Smith's new catalogue in retaining it in *Hydarcia*. I have always referred it to this genus." In view of this opinion, I have therefore used that generic name. This question is discussed at some length by Prof. Lintner in his First Report, page 115.

Remedies.—It will probably be found that the most effective remedy is the collecting by hand and destroying the young grubs before they leave the tips of the vines. An attacked shoot has a characteristic appearance which is recognized at sight by an experienced eye. When thinning and tying the vines such can be easily removed and the young caterpillar destroyed by crushing it. In Prince Edward county this must be done before the last week in May, and as the vines have to be trimmed and the shoots chosen for tying to the poles about that time, very little extra labour will be entailed.

Mr. Dodge, in his article above referred to, says as follows:—"Next to the crushing process, a useful remedy is to hill the hops as soon as possible and give the yard a thorough cultivation. The hilling causes fibrous roots to put out above the operations of the grub and save to some extent the crop." On the other hand, he speaks most highly of a method recommended by a New York grower of hoeing away the earth from the vines about the first of June, applying fertilizers to the roots and not hilling up till the end of July. Prof. Smith recommends this same treatment of exposing the roots, but says that five or six days, early in June, will be a sufficiently long time. The idea of baring the roots is to render them harder and more unattractive to the caterpillars, while hilling them up is to induce a free growth of secondary rootlets to repair injury and strengthen the vines.

I hope to induce some of our Canadian hop-growers to try careful experiments with different methods of treatment next year. At a meeting of the Dominion Hop-growers' Association, which I attended at Picton, Ont., in May last, I learnt that a kind of herring which is thrown up in large quantities on the lake shore, had been used as a fertilizer for hops, and that where this had been done the Collar-worm was far less abundant. On this point Mr. Cotter writes to me, Dec. 22nd:—"With regard to fish as manure for hops and to prevent attacks of the Collar-worm, Mr. Mathew Benson, ex-president of our association, tried it, and he believes it is a success. I have also tried ashes, and believe, as Mr. Benson does, that they are good—ashes in the fall, fish in the spring. I would state that my crop has never been so heavy since 1885 as it was this year, but great discretion had to be exercised in applying the manures best adapted for the different soils. My advice would be: Ashes for sand and fish for heavy soils, to fight the Collar-worm and not get too much growth of vine."

"Dec. 26.—A bull-head may be made into a good runner, if required, by nipping off one shoot at the crotch. Some growers have tried fish against the Collar-worm, and they say it works well, but I have had no experience with them. Wood ashes applied in the fall before manuring are very good."—JAMES CRAWFORD, *Bethel, Ont.*

I am of the opinion that the virtue of the fish as a preventive of Collar-worm attack is due chiefly to the offensive odour of the putrefying fish at the time the young caterpillars fall to the ground to attack the root. The ashes probably act only as a fertilizer, and would not have much value as a deterrent.

Mr. Dodge and subsequent writers on the Hop-vine Borer draw attention to the good services of skunks in destroying the caterpillars. Mr. Dodge says: "All growers speak most favourably of the friendly offices of these much despised animals in the hop-yard. They seem to have acquired the digging up process to perfection—far better than the hop-grower—as they are able to dig around the hills without the least injury to the vines. In Juneau County, Wisconsin, this little fellow—with an appetite for juicy grubs only equalled in degree by the pungency of his perfume—is the only positive remedy, as he works about the hop-hills or roots, cleaning out the worms in a few nights. One grower says: 'I have seen ten acres where not a dozen hills would escape their little noses.'"

"It is worthy of note that in a majority of cases the grower report the borer as the most injurious insect in the hop-yard, not excepting the hop-appia."

THE RED TURNIP BEETLE.

(Entomoscelis adonidis, Fab.)

Attack.—A showy scarlet beetle with three black stripes down its back, a black patch on the collar and black legs; two-thirds the size of the Colorado Potato-beetle, but narrower in outline, eating the leaves both as larva and perfect beetle of turnips, radishes, and cabbages.

During the past season, I have received further reports concerning the injuries of the Red Turnip-beetle to turnips and other plants of the cress family in Manitoba and the North-west Territories, and I again draw attention to it, as I am convinced that unless it is watched carefully, it may, with the increased cultivation of crops suitable as its food, develop into a serious agricultural pest, in the same way as was the case with the Colorado Potato-beetle, when potatoes were grown in large quantities in the districts which were its native home. In response to a request made in my last annual report, I have received eggs and living specimens, male and female, from several correspondents, and have thus been enabled to examine the larvae hatched from some of these eggs, and observe them through all their stages.

The depredations do not appear to have been so severe this season in some of the districts where they were most serious last year.

"August 9.—We have very few of the Red Turnip-beetles this year."—REV. F. R. HOLE, *Minnedosa, Man.*

"August 29.—The beetles are not so numerous as last year. They have only worked on radishes, but I think they are going to multiply, although no eggs have been laid yet."—JOSEPH A. SMITH, *Saskatoon, N.W.T.*

"September 1.—I send you by mail to-day a few Red Turnip-beetles, which have appeared on my white turnips. I have a few rows of white turnips in three different parts, within an area of four acres, and on each of the plots the beetles are to be found. Some Swede turnips are growing between two of the rows of white, but I do not find any of the beetles on these, nor upon some mangels growing alongside the turnips. The beetles seem to be the most troublesome on the driest land, and where the turnips are smallest. This would appear to be their breeding season, as many of them are in pairs."—WILLIAM LINDSAY, *Elkhorn, Man.*

"September 20.—In reading your report for 1891, I was specially interested in the account of the Red Turnip-beetle which has this year completely ruined my crop of Swede turnips. My experience with them is quite different from that of the majority of your correspondents, as my radishes which were growing only ten or twelve yards from the turnips were almost untouched; also a few rough leaved white turnips which were growing amongst the Swedes were scarcely touched. Last year I did not see one on the place. I herewith enclose what I presume are the eggs of the beetle; these I found after diligent search very lightly covered with soil. The eggs are deposited in masses slightly stuck together, but a very light shake seems to separate them. I have never seen any grubs on the turnip leaves. Is it possible that they remain under ground? Two or three days ago I noticed a gravid female crawl under a sod. I marked the spot, and this morning uncovered her; she was dead, and scattered around her were a number of eggs. In one spot there was a cluster as described above."—C. E. F. LOWE, *Yorkton, N.W.T.*

September 27.—I have discovered the eggs of *Entomoscelis adonidis*, I think, by thousands. I first found them on the surface of the ground under some dried up radishes (thinnings of the crop), which had been thrown aside. Following up the clue thus given, I found them under almost any slight covering, and sometimes only under a shade which did not amount to an actual covering. I also found them a quarter of an inch or so under the surface of the ground by the roots of rough-leaved turnips and radishes. I think the eggs were not placed there, so that the young larvae might be near suitable food on hatching, but that they are laid almost promiscuously under any slight cover or shelter. Where the beetles are plentiful the eggs are so also in proportion, and where the beetles are scattered widely apart as among grass or stubble the eggs are not found; but this is only, I believe, because the search is more difficult. The eggs are laid wherever the beetles happen to be

during the month of September and some of the females doubtless lay much earlier."—THOS. COPLAND, *Saskatoon, N.W.T.*

The above facts with regard to the egg-laying habits of this insect in a state of nature were precisely the same as I myself observed with several pairs kept in confinement for over a month upon growing turnips. Enormous numbers of the small reddish brown eggs were laid from time to time by the females, in loose masses of from 5 or 6 to 80. These were generally tucked beneath any small object on the surface of the ground or occasionally into the folds of a dead leaf on the ground. The usual habit, however, in nature is probably that the eggs are laid in clusters beneath sods or in cracks or other openings in the soil. Eggs laid in September were kept in my office quite dry until November, when they were slightly dampened, and on the second day afterwards the small larvæ appeared. This was probably due to the artificial heat of the office. In nature the eggs would not have hatched until next spring. The larvæ have fed readily upon all kinds of cruciferous plants offered to them. When first hatched garden cress was the only plant available and they took to it at once. Some seedlings of rape and the small shoots from the crowns of Swede turnips then formed their food until some radishes sown on the day the eggs hatched, were sufficiently advanced to feed them. This was for about a fortnight, since which they have been fed entirely upon radish leaves, and they seem to be perfectly healthy. They are very shy and drop from the leaves at the slightest disturbance, and this, I think, must be the reason why they have been overlooked by my correspondents.

The insect takes its scientific name *adonidis* from one of its food plants in Europe, *Adonis autumnalis*, a plant belonging to the *Ranunculaceæ*. It is, therefore, possible that it may feed naturally in the North-west upon some of the many plants of that order or upon wild *Cruciferae*, and thus have escaped notice in the larval stage. The eggs hatch early in spring and most cultivated cruciferous crops as turnips and cabbages are not planted until long after the young larvæ would have starved on cleanly cultivated land. On wild plants the larvæ would, of course, easily escape the notice of ordinary observers, and the presence of the insect would only be recognized when the perfect beetles flew to the fields from their breeding places and began destroying the crop. When once seen the larvæ will be easily recognized by the uniform dull black colour. It is also very advisable that farmers in Manitoba and the North-west Territories should know what it looks like, as soon as possible, so as to watch it carefully and keep it in check. The same insect occurs in Europe where it has occasionally shown its powers of doing injury. Prof. Riley has kindly referred me to the literature of this subject from which it appears that the larva was reported in Hungary in 1865 as having been very injurious to rape. In a description of the larva written for the "Annales de la Société Entomologique de France," 1890, II. pp. 177-179 by P. Lesne, it is reported as injuring the same crop in Roumania as follows: "The eggs, of the form and colour of the seed of Cameline* (gold of pleasure) but smaller, are laid in autumn. The larvæ appear the following spring, soon after the last frosts, when the winter colza (rape) is beginning to germinate, that is to say, the latter half of March. Larvæ and adults are very injurious to colza in Roumania, and in certain years whole crops are destroyed by them. Unfortunately it is very difficult to fight this species, especially in countries where at the least 100 hectares (247 acres) are given to the culture of rape. Droughts favour its multiplication, while cold and rainy weather greatly retard it."

Remedy.—As soon as the beetles appear upon turnips or radishes, the foliage should be sprinkled with Paris Green and water, 1 lb. to 100 gallons. From the fact that the eggs are laid in largest numbers on land where a crop has been attacked, of course, a similar crop should not be grown there the following season. If the black elongated larvæ are found abundantly on wild plants, these should be sprayed freely with Paris Green and water.

The Egg.—When first laid, orange red in colour, turning darker gradually until it is dark brown, elongated, oblong, sometimes slightly curved, 1.30 mm. long by

* *Camelina sativa*. False Flax.

.60 mm. wide. Surface minutely granular roughened; under the microscope, closely reticulated or mottled with small white circular marks in the centre of each of which are from 1 to 7 dark brown dots of the same colour as the intervals between the circles. These circular marks are not quite close enough together to give them a polygonal appearance; they vary in size the largest being about three times as big as the smallest. The eggs are laid in clusters loosely agglutinated together and deposited beneath clods or in crevices of the soil.

The Larva.—When just hatched, orange with black spots turning black in 24 hours, wedge-shaped, 2 mm. long, (2.55 mm. when extended); head black. .75 mm. wide, slightly wider than the anterior segments. Each segment bears 2 dorsal transversal rows of black tubercles, from 7 to 8 in each row and each one bearing a long slender bristle, which expands into a small knob at the apex. Thoracic shield, large, covering the whole upper surface of segment 2, and bearing about 20 bristles. Just above the stigmatal line, on each of segments 3, 4 and 5, is one large dark bristle-bearing tubercle; below the stigmatal line on each side is one series of large tubercles; one on each segment, each of which bears 2 or 3 bristles. There are also 2 ventral series of rather smaller tubercles. From 9th segment, the body tapers rapidly to the end. Antennae conspicuous, protruding beyond the cheeks.

After first moult, length 3.25 mm. (4 mm. when extended); body slug-shaped, flattened beneath, full and rounded above, not decidedly narrow at the collar as in the Colorado Potato-beetle, abruptly truncate in front, tapering behind to the prehensile bilobed anal joint. Head, sub-rotund, traverse, slightly depressed at apex. The whole body velvety black, of a reddish brown shade in some specimens, particularly beneath the spiracles, covered with transverse rows of elongated piliferous tubercles, three rows to each segment, composed respectively of 8, 6 and 6 tubercles in the first, second and third rows. Each segment is divided transversally into two folds, the anterior bearing the first to rows of tubercles and the posterior the third row. The tubercles of the second and third rows are much larger than those of the first. All the tubercles, the head, and the thoracic and anal shields, are shining black and covered closely with short blunt fuscous bristles, each tubercle bearing many bristles. Thoracic feet and spiracles, black. Underside, dull greenish black. Thoracic shield, large, covering the whole upper surface of segment 2, deeply impressed and roughened on each side. Below the spiracles is an infrastigmatal series of very large conical tubercles, and beneath this again a supraventral series, half the size of the above. On the ventral surface are five series of tubercles, the central series occurring on every segment. There is a narrow slightly depressed dorsal groove running from the apex of the head the whole length of the body, distinct and pale where it crosses the thoracic shield and the third and fourth segments.

After second moult, length 5 mm. (7 mm. when extended); ornamentation and colour, the same as in previous stage.

Mature larva, length about 12 mm. The body and appendages as described above.

After the second moult, the colour gradually changed as the larvæ matured. The ground colour above the spiracles retained its velvety appearance, but on the underside the skin seemed thinner and more translucent, the orange juices of the body showing through it and giving a dull orange hue to that portion. This was much more apparent in some specimens than in others. One or two pale specimens were distinctly bi-coloured, black above and yellow beneath: but the general appearance of the mature larva should be described as an elongated narrow grub, black above, yellowish beneath, and half an inch in length by one-eighth of an inch in width. In confinement the larvæ fed both day and night. They were comparatively active, but dropped from the food plant at a slight disturbance. Beneath segments 9, 10 and 11, counting the head as the first segment, are three pairs of small bag-like translucent extensible pseudopodia or false feet. These are used as prolegs, and appear to be extended at will from median slits in the ventral surface. In walking, these organs and the anal bilobed process are distended with the fluids of the body and seem to be of equal value in progression with the thoracic feet.

The Pupa.—Length, 6 mm. by $3\frac{1}{2}$ at widest part; bright orange. The wing, leg and antenna cases, honey yellow; head, folded down on the breast. Wing cases, bearing each three longitudinal striae. Spiracles, round and fuscous. Dorsal vessel, conspicuous as a dark stripe. Metathorax, bearing a shallow median dorsal groove. Thorax and a median transverse ridge on each segment of the abdomen, closely covered with short bristles.

When full grown, the larvæ buried themselves in the earth of the breeding jar to a depth of about an inch from the surface, and changed at once in small smooth cavities to orange pupæ, of a shape very similar to that of other Chrysomelidæ, which is well shown in Prof. Riley's figure of the Colorado Potato Beetle first published in his first Missouri Report, fig. 46 c., page 101. In the pupa of *E. adonidis* the abdomen is more pointed at the apex, than shown in the figure.

In the above instance, the eggs hatched in my office on November 18th, 1892; some larvæ were full grown and buried about January 1st, 1893, and several beetles emerged January 30th.

WESTERN BLISTER-BEETLE.

(*Cantharis Nuttalli*, Say.)

Attack.—Large handsome beetles, one inch long, with plum-coloured, purple or green wing cases, glossed with gold. Head, thorax and body metallic green, with the same golden sheen as the wing cases. Feelers, dull black; legs, dark purple. These insects appear suddenly upon beans and vetches in July and devour the foliage rapidly.

Occasionally reports are received of injuries done by the above named beetle, but during the past season these have been unusually numerous, as shown by the following quotations from some of my correspondents:

"Feb. 4th.—There is in this country, a beetle varying in colour, which is blue or changing violet-green or blue with golden lustre, about an inch long by a quarter of an inch wide, which feeds on leguminous plants and is very fond of both the tender leaves and flowers of Windsor Broad Beans. I will send you specimens next summer.

"July 18.—I send you herewith a few of the beetles with their favourite wild food-plant.* They made their first appearance about July 1st. On July 4th it was very hot and they came in swarms, attacking the bloom of Windsor Broad Beans, which in some gardens they completely destroyed in a few hours. I partially saved my crop by hand-picking, gathering nearly two quarts from the beans. These beetles are sure to be a serious pest if they attack anything else.

"Aug. 22.—The season of the *Cantharis* is quite over now.—THOMAS COPLAND, Saskatoon, N. W. T.†

July 5.—Yesterday I noticed a large number of beetles feeding vigorously on my patch of Windsor Beans. The beans were in full bloom and the insects were just beginning to feed on the blossoms. To-day, the whole patch is destroyed. I send two pairs of the insects for identification and any other information you can give me. They first devoured all the blossoms and are now feeding on the more tender leaves. I have not discovered them feeding on anything but the beans yet, but fear they may try the taste of other garden stuff. I had not seen any this year until yesterday, and although I have noticed a few in other years, they have done no damage that I have seen. Are they known to do much damage to vegetation, and if so, what is the best way to destroy them?"—GEORGE L. SMITH, Saskatoon, N. W. T.

"July 19.—I send you specimens of beetles which have totally eaten up some Horse Beans which were growing splendidly, and to all appearances would do well in this country and be a paying crop. But if these pests are native and likely to turn up every year, there would not be the slightest use in trying to grow them, as the beetles were literally black on the plants. Can you tell me what they are and if they are liable to come every year?"—CHRIS. HALLIDAY, Winlaw, Assa.

* This was *Vicia Americana*, a wild vetch.

† Prof. Saunders found this insect extremely abundant in August upon cultivated tares growing near the Experimental Farm at Indian Head, N. W. T. They were so numerous that the crop was materially reduced by their devastations. They were not found upon any other crop at that time.

The actual life history of this interesting insect has never been worked out, but from what is known, chiefly through the studies of Prof. Riley, of the life history of allied insects, there is every probability that during its larval state it lives on the eggs of different kinds of Locusts.

At the last meeting of the Association of Economic Entomologists at Rochester, N.Y., Mr. L. O. Howard stated that the experience of farmers in the Western States had been similar to ours, and that different species of blister-beetles had been sent to the department with reports of damage from various parts of the country. He suggested that their extraordinary abundance was probably due to the large numbers of grasshoppers last year. Prof. Forbes also said on the same occasion that some years ago in Illinois these beetles had been exceedingly and destructively abundant, following a season of great abundance of grasshoppers. Judging from the past, there is little fear, I think, that this beetle will appear in destructive numbers every year. In looking over all the reports received concerning the depredations of this insect, I find that they are all dated early in July, so that the time of injury would seem to be limited to a few weeks, and if a sharp watch were kept for its appearance, the ravages could be controlled either by sweeping the crop with a net mounted on a handle or by beating the beetles into a pan containing some water with a little coal oil on the top. Where the area attacked was too large for this, spraying promptly with Paris Green, 1 lb. to 100 gallons of water, would destroy them.

The Western Blister-beetle is hardly likely to be a general feeder upon garden produce although some specimens received living were kept alive for some time and fed upon clover and pea-vines. They did not however seem to relish these plants.

THE BIRCH BUCCULATRIX.

(*Bucculatrix Canadensisella*, Chamb.)



Fig. 14. *Bucculatrix Canadensisella*: a, part of attacked birch leaf; b, pseudo-cocoon; c, larva; d, head of same; e, anal segment of same; f, anal segment of pupa; g, cocoon with extended pupa skin; h, moth—all enlarged. (Kindly lent by Prof. C. V. Riley.)

Attack.—Numerous, slender pale greenish caterpillars, when full grown, $\frac{1}{4}$ of an inch in length; body, slender, tapering to each end, sparsely covered with fine bristles, the sutures between the segments deeply impressed; eating out portions of either the upper or lower sides of birch leaves, and leaving the epidermis of the opposite surface intact. The injuries become noticeable in August when the trees begin to assume a rusty or burnt appearance and many of the leaves fall prematurely. This attack may be recognized by the presence on the leaves of small white circular flat webs, which are spun by the caterpillars, as temporary shelters during the time that they are casting their skins. These have been styled cocoonets by Mr. V. T. Chambers (Can. Ent. XIV, p. 145); but are more properly called pseudo-cocoons by the Editors of *Insect Life* (Vol. V, p. 16). The true cocoons are spun later and are oblong, flattened beneath and longitudinally ribbed with about eight prominent ridges, a little over $\frac{1}{4}$ of an inch in length, of a pale greenish yellow at first, but afterwards dark brown, of the colour of the twigs, on which they may be very rarely found in winter.

For the last three years the birches of all kinds in the vicinity of Ottawa, but particularly on the wooded slope surrounding Parliament Hill, have been much disfigured by this insect. Upon the Experimental Farm, the attack was most severe

in the case of the varieties of *Betula alba*, but our native birches, *B. papyrifera* and *B. lutea*, have been hardly less injured.

The caterpillars were so numerous that five or six would be frequently found upon a single leaf, and the effect of their depredations was soon perceptible after they were first observed. They were particularly partial to the beautiful pendulous cultivated variety of the European birch, known as the Cut-leaved Weeping Birch, which is in the opinion of many the most beautiful ornamental tree grown.

The only remedial treatment tried was spraying the trees with a weak Paris Green mixture. This was found to be quite effective.

With regard to the life history of this genus, Mr. Chambers says as follows (Can. Ent., XIV, p. 154):—"The larvæ of several species of *Bucculatrix* are known in Europe; but in this country until now (1882), Dr. Clemens's 'mere mention' of the larva of *B. pomifoliella*, Clem., is all that has been published. Briefly, the larval habits of the genus may be thus summarized. The larva, while very young, mines in leaves, and leaving the mine, it feeds externally, moulting once in a little cocoonet, and again in a singular ribbed cocoon where it passes the pupa stage."

Further on in the same article, the detailed description of *B. ambrosiaefoliella* shows that the egg, a minute colourless globule, is deposited on the upper surface of the leaf, and the larva, after leaving it, mines inside the leaf, where, in three or four days, it passes the first moult. After this it leaves the mine and feeds externally until the time for the next moult, when it spins beside a rib a thin sheet of white silk; beneath this it spins a small circular cocoonet, in which the body of the caterpillar is doubled into a horse-shoe shape and the second moult is passed. Emerging from the cocoonet the caterpillar feeds externally for a few days, when, either on or near the plant, it spins the ribbed cocoon in which it passes the pupa state.

In confinement, the cocoons are nearly always spun upon the leaves, but it is very rare to find them in that position in nature. The only cocoons which I have found upon the trees, were spun on the sides of twigs, where they bore a close resemblance in colour and shape to the winter buds. From the small number, however, three only, upon a tree where thousands of the larvæ had occurred, it seems unlikely that this is the usual position of the cocoons, and it may be that they drop to the ground and spin on low plants or other objects. In confinement, the moths emerged from cocoons kept all the winter in a warm office, in the beginning of January, but none were observed out of doors until July, nor was there any trace of a spring brood of caterpillars.

The cocoon is an object of great beauty and of no less interest when the caterpillar is observed building it. I was fortunate enough to detect a caterpillar in the act of beginning its cocoon, and was able to watch the process of construction. The insect lay extended on the leaf moving only the forepart of its body. A mat was first spun on the surface of the leaf, then the foundations of the ribs were begun of silk, which hardened almost instantly after exposure to the air. Little by little these were continued, and the meshes of an open net-work stretched between them, the caterpillar all the while retreating backwards as the structure advanced. The hut-like frame was gradually enlarged, until the middle was reached, and then tapered off toward the other end, up to four-fifths of the total length. So far the work has all been done from the outside. The little builder now crawls inside the frame work, and turning round, protrudes its head from the open end, begins again in the same way as it had first started the cocoon, and continues until the two portions touch. These are then joined together by silken threads spun from one to the other inside. The caterpillar is now completely enclosed in an open framework, and, as Mr. Chambers points out, if the larva ceased to spin at this stage, the cocoon would belong to the same class as those of *Plutella cruciferarum*, and a few others which pupate in an open net-work. But it immediately begins to spin the oval true cocoon inside this, and soon becomes invisible, and the cocoon darkens in colour.

In the article above referred to by Mr. Chambers, "Notes on the larva of *Bucculatrix ambrosiaefolia*" (Can. Ent. XIV, p. 153), an extremely interesting account of the insects of this genus is given and also a detailed description of the building of

the cocoons which he had watched under the microscope, together with a figure illustrating the way in which the longitudinal ribs are built up and strengthened little by little to support the transverse thread.

There are still some points of interest in connection with this little insect which require further study. I have found upon the leaves small mines which I presume were made by the caterpillars in their first stage, but I have not actually found the larve of *B. Canadensisella* in these mines, nor discovered the eggs. It is important to find out the usual location of the cocoons in which the insects pass the winter. *B. pomifoliella*, which is occasionally injurious to the foliage of apples trees, and was this year very abundant at St. Catharines, Ont., spins its elongated whitish cocoon on the twigs of apple trees.

In the autumn of 1889, I found large numbers of the cocoons of another species shaped somewhat like those of *B. Canadensisella*, but rather longer and pure white in colour. These were attached to dead grass leaves and the fruiting stems of a moss, under sugar maples. It seems possible that these may have fed upon the leaves of the trees and fallen to the ground when ready to spin. I hope next season to work out completely the life history of the Birch Bucculatrix. I append a description of *B. Canadensisella*.

Moth small, wings expanding $\frac{3}{4}$ of an inch. General colour, bright brown, the wings crossed with silvery white bars, three of these run from the outer edge about half way across the wings obliquely towards the apex, and there are two shorter subtriangular blotches on the inner margin of each fore wing. These latter, when the wings are closed, form two white dorsal saddles, the anterior of which is slightly the larger, and is followed closely by a tuft of raised black scales. At the extremities of the fore-wings are also several raised black scales a few of which are separated into an apical spot by an irregular narrow white band. The cilia of the fringes are pale brown. Head white; frontal tuft dark brown in the centre; antennae brown, slender, about $\frac{1}{2}$ inch long. Thorax brown with margins including the bases of the fore-wing, white. Leg and body pale fuscous silvery.

Fig. 14 showing the various stages of the Birch Bucculatrix has been kindly lent for use in this report by Prof. C. V. Riley, and was originally used to illustrate an article by Dr. A. S. Pockard, the most complete yet written on the species, which appeared in *Insect Life*, vol. V. p. 16.

ON AN EGG PARASITE ON THE CURRANT SAW-FLY.

(*Trichogramma*, sp.)

Under the above title Professor Lintner published in his Second Report, 1885, an interesting account of a minute parasite which he had discovered in 1867 and again in 1882, attacking the eggs of the Imported Currant Saw-fly in the State of New-York. This injurious saw-fly, the larva of which is usually known to Canadian fruit-growers as the "Currant Worm," is a pest which demands constant attention throughout the summer, and although the ordinary applications of Paris Green early in the season and White Hellebore later on when the fruit is formed, perfectly efficacious, cheap and simple; yet, there is hardly a district where plantations may not be found stripped of every leaf during some part of the season. It is not well enough appreciated by fruit-growers that if the leaves be stripped from a bush either by fungous or insect enemies, even after the crop is gathered, they suffer much loss thereby; for without leaves the bush cannot store up nourishment to support the crop of the next year, and although there might be abundance of flowers, the fruit will drop without maturing from bushes which were stripped the year before. In view of the above, the discovery and distribution of a parasite which would keep in check such a redoubtable enemy, becomes an important matter.

I was therefore very much pleased on the 10th of last June to find upon the leaves of a gooseberry bush in the garden of Mr. R. Montfort, at Galetta, near Arnprior, Ont., eggs of the Imported Currant Saw-fly, which showed evident signs of containing parasites. Instead of presenting the usual translucent white appearance, they were shining jet-black and showed the shape of the pupa of the parasite within.

Some of the eggs contained two parasites in different stages of development when half the egg was black and the other half paler. Only a few eggs could be found on the occasion of my visit, but later, through the kindness of Miss Montford, I received a much larger supply of parasitised eggs, some of which were distributed to different gardens, in the vicinity of Ottawa. I soon found, however, that the friendly parasite was already present in strong force and I collected parasitised eggs in all the gardens I had opportunities to visit. The specimens bred by Prof. Lintner were identified as *Trichogramma pretiosa*, a species originally described by Prof. Riley (Can. Ent. 1879, pp. 161-162) from specimens reared from the eggs of the cotton moth (*Aletia argilleceae*, Hüb.) As the specimens bred at Ottawa this year did not seem quite to agree with the description, some of them have been submitted to Prof. Riley, together with several specimens bred from the eggs of another introduced saw-fly which has appeared in injurious numbers upon Russian Willows at Quebec and Ottawa. His report upon them is as follows:—

"So far as can be seen from the dry specimens of the two *Trichogrammas* from *Nematus ribesii* and *N. pallidiventris*, they are the same, but no satisfactory examination can be made of specimens in the condition. *Trichogramma*, like *Aphelinus* and the other little yellow-coloured, thin-skinned Chalcidids, should be mounted when fresh in balsam. It is a most difficult thing, however, to distinguish between the species of the genus." I exhibited some of these specimens at the Rochester meeting of the Association of Economic Entomologists, and Mr. L. O. Howard then told me that the genus was a most discouraging one, that he had examined carefully under high powers of the microscope some hundred of specimens, but could find no good characters by which to separate the species; the apparent characters, viz., in the arrangement of the little hairs on the wing and the number of cells in the uncus of the stigmal club are worth nothing, and vary in individuals reared from the same batch of eggs. He agreed with Prof. Riley that the only thing to do was to wait until abundant material had been collected, when probably characters for separation of the species would be found, but it would only be by careful study and a survey of the entire field.

SOME OTHER USEFUL PARASITES.

In addition to the above record, some other equally interesting parasites came under my notice during the past season, a few of which I will mention to show the good offices performed by others as well as these minute and almost invisible insects.

The different species of *Trichogramma* are minute, four-winged, yellow insects, varying from about one hundredth to one twentyfifth of an inch in length, with front wings broadly expanded towards the apex and ornamented with lines of hairs radiating from the base. The hind wings are narrow and more deeply fringed than the other pair. They are parasites on the eggs of many kinds of insects, frequently more than one specimen emerging from a single egg.

PARASITE OF AN IMPORTED WILLOW SAW-FLY (*Nematus pallidiventris*, Fallen).—In 1891 the Rev. T. W. Fyles, of South Quebec, recorded (Can. Ent., XXIII, p. 135) the first occurrence of this saw-fly in America. He had reared it from specimens found upon a lately imported Russian willow growing in his garden. In September last this same species was found abundantly ovipositing upon the leaves of terminal shoots of *Salix laurifolia* in the botanic garden at the Central Experimental Farm. The eggs are inserted beneath the epidermis of the lower side of the leaves in open clusters of from about half a dozen to one hundred. Each egg is separate, and causes a comma-shaped swelling. The eggs hatch in about ten days, and the voracious larvæ soon strip the shoots, entirely consuming the leaves as they work down from the top. They rest when half grown on the edges of the leaves, the curved bodies standing out like a heavy fringe. They are dark green dotted with black, somewhat like the larvæ of the Imported Currant Saw-fly, to the perfect insect of which this also, although brighter-coloured bears a considerable resemblance. Great numbers, of the egg-clusters, upon examination, showed the dark colour indicative

of the presence of parasites within the eggs. Leaves enclosed in jars, gave, a month later, specimens of the *Trichogramma* very similar to the species bred from the Imported Currant Saw-fly.

PARASITE OF THE TIGER SWALLOW-TAIL (*Papilio Turnus*, L.)—The following instance will illustrate the very small size of the parasites of the genus *Trichogramma*, and the good work they are capable of performing will be shown below under "Parasites of the Zebra Caterpillar." On July 11, I found a single egg of *Papilio Turnus* upon a low bush of *Amelanchier Canadensis*, T. and G.



Fig. 15. *Trichogramma minutum*, Riley.

at Nepigon. This egg was shining black in colour, so was carefully enclosed in a small glass bottle to secure the parasites. In due time they began to emerge, and at length no less than forty-one specimens came out from the one egg, which only measured 1 mm. in height by 1.10 mm. in breadth. The species has been identified by Prof. Riley as *T. intermedium*, How., a species closely resembling *T. minutum*, Riley, which was originally described from the eggs of *Limnitis Disippus*, a common butterfly.

In Mr. Scudder's "Butterflies of the Eastern United States and Canada," is recorded an instance where seventy-nine specimens of *Trichogramma minutissimum* were bred from five eggs of this same butterfly, making an average of sixteen to each egg. Prof. Lintner states that six specimens of *T. minutum* have been reared from a single egg of *L. Disippus*.

PARASITE OF THE VANCOUVER ISLAND OAK-LOOPER (*Ellopiia somnaria*, Hulst.)—The oak trees in the vicinity of Victoria, B.C., have been for many years periodically stripped of their foliage, for a few years in succession, by myriads of the larvae of the above named insect; then for a few years the trees are exempt from injury. This has been noticed by many of the citizens of Victoria and there has been much speculation as to the cause of the sudden disappearance of the marauding hosts. From material kindly sent to me, and with the valuable assistance of Mr. W. H. Danby, of Victoria, I have been able to discover several of the causes which periodically check the undue multiplication of this pest. The most effective of these is a fungous disease which has been identified by Prof. Roland Thaxter, as *Sporotrichum globuliferum*, Spegazzini as recorded in my last report. This attacks the insect in all stages of development.

From the chrysalides, Mr. Danby and I have bred numerous specimens of a yellowish Ichneumon fly (*I. cestus*, Cress.) which is easily recognized. The length is about three-eighths of an inch, and the whole body is yellowish orange with one black band across the abdomen. Besides this, a new species of *Pimpla* was bred from pupae sent to me by Mr. Danby. This has since been named by Mr. W. H. Harrington, *Pimpla ellopiæ*, Har. (Can. Ent. XXIV. p. 99).

The above-named parasites reduced the numbers of the caterpillars last year enormously, but there was yet another enemy awaiting them. *E. somnaria* passes the winter in the egg state, tucked beneath mosses or flakes of bark. Very few eggs were to be found on the bark last winter and nearly every specimen of such as were discovered in two large consignments of bark sent by Mr. Danby, were found to be parasitised by a minute black Proctotrypid which Prof. Riley informs me is an undescribed species of *Telonomus*. Only one egg produced a caterpillar which was bred to maturity in my office upon a growing oak seedling.

PARASITES OF THE ZEBRA CATERPILLAR (*Mamestra picta*, Harris.)—I know of no plant or shrub which this bright coloured caterpillar will not attack and it is frequently a source of considerable injury. It was sent in from several localities during the summer as a pest upon cabbages and potatoes. During September I found upon a plot of Bokhara Clover (*Melilotus alba*, Lam.) hundreds of clusters of the eggs of *Mamestra picta*, many of which showed from the colour that they were parasitised. The eggs were laid in a neat close patch, entirely covering the under-

side of a leaflet right up to the edges. When parasitised they were of a dark leaden hue. Several of these egg-patches were enclosed in glass jars and in a few days thousands of specimens of a species of *Trichogramma* and about an equal number of a tiny black parasite, were found in the jars, the former of these was named by Prof. Riley *T. pretiosa* and the latter *Telonomus* (new species). Of the large number of egg-patches of *M. picta* which were collected, not one per cent gave the caterpillars of the moth, owing to the attacks of these parasites.

PARASITE OF THE LESSER GRAPE-VINE SPHINX (*Ampelophaga myron*, Cram.) AND TOMATO SPHINX (*Protoparce celeus*, Hüb.).—During the past summer, both of the above caterpillars were unusually abundant in western Ontario; very few however, apparently came to full growth, on account of the attacks of the small Braconid, *Apanteles congregatus*, Say. The eggs of this insect are laid by the female fly within the body of a caterpillar by means of a needle-like ovipositor, with which she pierces the skin. Sometimes as many as 200 eggs are laid in a single caterpillar (207 cocoons of this parasite were actually counted on a large specimen of the Tomato Sphinx found in London, Ont.) The young maggots upon hatching feed on the fatty parts of their victim and, when full-grown, force their way through its skin, and work themselves out as far as the last joint of their bodies, when they begin spinning their



Fig. 16.—Cocoons of *A. congregatus* on Sphinx caterpillar.

small white cocoons, which stand on end and present the appearance of fig. 16. From these eventually the small active black four-winged flies emerge. Besides several parasitised specimens of the Lesser Grape-vine Sphinx, which I received from correspondents, there were also some caterpillars of the Tomato Sphinx sent in for report. Mr. W. W. Hilborn, of Leamington, Essex Co., Ont., says: "I am glad to learn what you write with regard to the parasite of the Tomato worm. Never until this season, has the caterpillar of the Sphinx moth done much injury. This year both tomatoes and potatoes have suffered. In some places whole fields have been destroyed. I have about three-quarters of an acre of early tomatoes that have been injured very much, although we hand picked the caterpillars every day for some time. A week or two ago we found a few which were parasitised like the one I sent you. We did not disturb any of the caterpillars which were thus affected and now there are hundreds of them. In fact, there are now (21st August) very few that are not parasitised. I sincerely trust that this parasite will continue its good work." I found on enquiry that practically the same state of affairs as is described by Mr. Hilborn, existed over a large district in western Ontario. I give herewith a figure from which the appearance of a sphinx caterpillar bearing the cocoons of the beneficial parasite is plainly shown. It will be well if all who see such will endeavour to restrain what appears to be an instinct in man, to destroy everything belonging to the animal world, which they do not understand or which they are not afraid of.

DIVISION OF BOTANY.

POTATO-BLIGHT AND POTATO-ROT.

The disease known as Potato-rot (*Phytophthora infestans*, de By.) is now well established in all the potato growing countries of the world and causes more loss to the potato crop than all the other sources of injury combined. In rainy seasons it is considered inevitable by most farmers, as a result of the wet conditions alone. This, however, is not the case, and it is important to have it well understood, as soon and as widely as possible, that this disease is due to the attack of an easily recognized vegetable organism belonging to the class of fungous parasitic plants, and further that careful experimentation has proved the possibility of preventing a large proportion of the loss by a systematic treatment with certain chemical mixtures as described below.

Many letters of inquiry having been received from farmers in all the eastern provinces of Canada, I considered it advisable to write the following letter, copies

of which were sent to several of the leading newspapers for publication early in July.

There are some facts which should be kept constantly in mind. 1. The Potato-blight of the leaves and the Potato-rot of the tubers are both due to the same cause. 2. This cause is a fungus which can be controlled. 3. The dry-rot seen in potatoes when they are planted in the spring as seed, produces both the blight on the leaves in August and the wet-rot of the tubers in autumn. 4. No potatoes containing patches of dry-rot should be planted as seed.

REMEDY FOR POTATO-ROT.

"OTTAWA, July 7th, 1892."

"To the Editor of—"

"SIR,—There are few diseases of field crops which are the direct cause of more loss to the farmers of Canada than that which is known under the different names of 'Potato-rot,' 'Potato-blight' or 'Potato-rust.' My object in writing this letter is to draw the attention of your readers to the fact that a practical and simple remedy has been discovered, and that the best time for applying it is during the latter half of this month.

"This disease of the potato is due to the attacks of a parasitic fungus, known by the name of *Phytophthora infestans*. The life history of this fungus is briefly as follows: The fungus passes the winter inside the potato tuber and is planted with it in the spring. As soon as the potato throws out its shoots, the parasite grows with it, running up through the tissues of the stems, and from about the end of July produces beneath the leaves an abundance of spores, or seed-like bodies. These are exceedingly minute, but are produced in such numbers that they frequently give a frost-like appearance to the under sides of the leaves. When these spores are produced on the leaves the appearance known as 'rust' shows itself in the shape of dark brown spots, which are caused by the drying up of the tissues, from the parasite having used up their contents. From the rust stage all future infection takes place. Some of the spores are carried by the wind and falling upon the leaves of other adjacent plants, produce more rust spots, while others falling to the ground are washed beneath the surface, and reaching the forming tubers produce the rot stage. The wet-rot, as seen in autumn in the tubers, is the form of this disease which is best known, but Potato-rot is really a dry rot which kills the tubers, and in autumn the wet-rot follows as a result of decay. In winter the disease occurs in the tubers, as patches of hard, whitish, diseased tissue.

"In this district the rust stage does not generally appear until about the first of August and this is the first evidence that blight is present in the field. As a rule the dark spots appear only on a few leaves at first, but if the weather be favourable the disease spreads rapidly from spores carried by the wind from these centres of infection, so that a large field may become diseased in a few days, and as a result the crop of potatoes ruined.

REMEDY.

"Careful experiments have shown that by spraying the potato haulms at the time the rust first appears, with the mixture of sulphate of copper and lime, known as the 'Bordeaux mixture,' the rust or blight on the leaves can be stopped, and as a consequence a large proportion of the rot in the tubers can be prevented.

BORDEAUX MIXTURE.

Copper sulphate	6 pounds.
Lime, fresh	4 pounds.
Water	45 gallons.

"To make Bordeaux mixture—Take six pounds of copper sulphate (blue vitriol) powdered, and dissolve it in one gallon of hot water in a wooden tub (iron must not be used, as the vitriol would attack it.) Slake four pounds of lime in sufficient water

to make a thin whitewash. Strain this through a fine sieve or a sack to remove all lumps. When both liquids are cool, pour the lime-wash into the copper sulphate solution, stirring it all the time. Now add enough water to make forty-five gallons, and the mixture is ready for use. It is best to prepare the mixture some time before required, but it must be kept covered to keep out all dust and rubbish.

"To apply this mixture to the foliage, undoubtedly the best and cheapest way is to use a proper spraying pump and nozzle, but if these are not on hand, good results which will well repay the trouble, may be obtained by applying the mixture with watering cans supplied with fine rose. There are several different kinds of spraying pumps in the market. Perhaps the most convenient for this work is a force pump attached to a barrel on wheels, to be drawn through the field by a horse. Smaller machines, known as Knapsack Sprayers, consist of a reservoir containing a small force pump, which can be carried upon a man's back. Both of these kinds of pumps can be purchased for about \$10 to \$20. It will be necessary to spray the fields two or three times to protect the crop thoroughly. There is no danger of injuring the foliage with the above mixture, as it is only half the strength of the original formula which is generally used.

"A great advantage of this mixture is that Paris Green, the only practical remedy for the Colorado Potato-beetle, can be applied at the same time. To do this, mix from a quarter to half a pound of Paris Green with a little water so as to make a thick paste, and then add it to the 45 gallons of Bordeaux mixture; that is, it is used in exactly the same strength as with plain water.

"These mixtures must be kept constantly stirred while being used, as both the lime in the Bordeaux mixture and the Paris Green sink quickly to the bottom of any mixture if left undisturbed."

The above recommendation was carried out here on the Central Experimental Farm amongst other experiments, Paris Green being added in the proportion of 1 lb. to 90 gallons of the Bordeaux mixture, and on the whole it produced as good results as any of the several mixtures tested. The insects which gave most trouble at Ottawa this season were, the Colorado Potato-beetle (*Doryphora 10-lineata*, Say). The Cucumber Flea-beetle (*Epitrix cucumeris*, Harris.) which eats small holes in the surface of the leaves, and Professor Jones, of Vermont, thinks it thus makes a starting point for the fungus *Macrosporium solani*, to injure the tissues. Later in the season the Large Red-headed Flea-beetle (*Systema frontalis*, Fab.) caused injuries similar to those of the last named enemy. All of these were kept in check by the Paris Green and Bordeaux mixture combined.

Having had considerable correspondence with Prof. L. R. Jones, Botanist to the State Agricultural Experiment Station at Burlington, Vermont, about the best means of controlling this disease, a series of joint experiments was planned, to be carried out contemporaneously at Burlington and Ottawa, with the same mixtures and as far as possible, with the same varieties of potatoes. The results of these experiments will be very useful for comparison with later work; but owing to unforeseen circumstances it is unadvisable to give now the full details of this year's experiments at Ottawa. These circumstances were, in the first place a very great inequality in the character of the soil in different parts of the field where the plots were measured off for trial; a severe and prolonged drought set in during the month of July and lasted till the 28th of that month, so that many of the varieties in poorer parts of the field were injured beyond recovery. This drought was more severe on account of following a very wet June. Again the Potato-rot was far less prevalent last season in this immediate district than usual, so that although there was practically no rot among the sprayed potatoes, neither was there any worth mentioning among those which were not treated.

I may however state that the general results were most encouraging, and the effect of the different treatments was conspicuously apparent upon the block of sprayed potatoes, which occupied the middle of the field, as compared with those which surrounded them, and which had been left unsprayed. Untreated vines had lost every vestige of foliage by the beginning of September, while some of the sprayed varieties remained perfectly green up to the time the crop was dug, on October 8th.

The defoliation this year of unsprayed vines was probably due more to the attacks of another disease caused by the fungus *Macrosporium solani*, and of insects, than by the true Potato-blight. Upon sprayed vines, however, these were not nearly so injurious, and although after all the unsprayed vines had been defoliated the insects congregated in myriads upon the still green leaves of the sprayed plots, and many of the plants were little by little eaten away, enormous numbers of the insects were found dead which had paid for their meal with their lives. The importance of the foliage being preserved as long as possible, was shown by the far larger crop of those varieties which held their leaves longest, and this not so much in the number of tubers as in their size. Two varieties which were remarkable for their power of resisting all enemies were "Holborn Abundance," and the "State of Maine." The following varieties were also noticeable, McIntyre, Empire State, St. Patrick, Clark's No. 1, Burpee's Surprise, White Star, Mammoth Prolific.

LAWN GRASSES AND FODDER PLANTS.

The experiments in testing the value of various foreign and native fodder plants, have been carried on in accordance with the plan already treated of at some length in previous reports. During the past season about one hundred and fifty different species and varieties were cultivated at Ottawa, and notes taken of their yield per acre, nutritive value, hardiness and suitability for agricultural purposes. One hundred and sixty-one collections containing seeds of thirteen of the most promising varieties of grasses, in all 2,173 samples, were distributed to be tested in the different provinces of the Dominion. In addition to the above, twelve larger samples of the valuable Austrian Brome grass were sent out for testing on a larger scale. The grass plots proved an attractive feature of the farm work to the large number of farmers and botanists who visited the Central Farm. An interesting addition was made to the collection of fodder plants, in the shape of all the different varieties of clovers of which seeds were advertised for sale by seedsmen in this country and in Europe. These were all sown last spring and made a good growth for the first year; but it remains to be seen how they will pass the winter.

Attention was also given to the important question of Lawn Grasses, with regard to which perhaps more enquiries are received than any other subject connected with grasses. An interesting bed was laid out in the shape of "a grass mosaic," sown in the pattern of the "Union Jack." The plan was suggested to me by Mr. J. B. Oleott, of South Manchester, Conn. A plot two rods long by half a rod wide, was sused for the purpose. First of all a wide St. George's cross (one foot wide) was sown in the centre with Hard Fescue (*Festuca duriuscula*); lying over this, the two entres meeting, was a St. Andrew's Cross of half the width (six inches), sown with Sheep's Fescue (*Festuca ovina*), and the eight angular spaces lying between the limbs of the two crosses were sown with different grasses. These were chosen so as to give the greatest variety of colour. In the very centre where the crosses met a small patch of another grass was planted. The object of this experiment was to show the unadvisability of sowing lawns with mixtures containing a large number of different varieties of grasses. What is required in a lawn is a sward of uniform colour and even texture. This cannot be secured if many varieties are sown together. When examined, grasses will be found to vary very much indeed, both in colour and the nature of their leaves, as to width, fineness and rigidity. This fact was well illustrated by the plan adopted, which attracted the favourable notice of many visitors. The satisfactory conclusion was arrived at that for good lawns in Canada, no grass could compare with the common June grass of our roadsides (*Poa pratensis*, L.), also called "Kentucky Blue-grass," or Spear grass, and in Europe, Smooth Meadow-grass. For a permanent bright colour, evenness of growth and softness of texture, as well as its iron-clad hardiness and power to withstand abuses, this grass has no equal. It was, too, almost invariably proclaimed the best in appearance, by all who were asked for an opinion, whether they knew the different grasses or not. The seed is easily procured, is cheap and is nearly always clean,

as it ripens its seeds before most of the weeds which grow among grasses. Enough seed for a good large lawn can be gathered in an hour by the roadside at the end of June by anyone who will take the trouble to do so. After a week this will be dry enough to rub out all the seed, which may be sown at once. For a successful lawn, the soil should be of good depth and well drained. The surface should be ploughed, levelled, and rolled smooth in autumn. In the spring it should be again rolled, the seed sown and then lightly rolled or raked in. The seeding should be thick, in the proportion of as much as 3 to 3½ bushels of June grass to the acre, to which ½ lb. of White Clover may be added. If the soil be moist, about half the above quantity may be made up of one of the many fine-leaved forms of *Agrostis* or Bent grasses, such as *A. stolonifera*; but the colour of this latter is of a decidedly different shade of green, and it must be done with the idea that the Bent grass, if more suitable to the soil, is ultimately to supplant the June grass. In the mosaic mentioned above the following grasses were used.

1. Hard Fescue (*Festuca duriuscula*), dark blue-green (hair-like leaves).
2. Sheep's Fescue (*Festuca ovina*), yellowish green (hair-like leaves).
3. Wood Meadow grass (*Poa nemoralis*), intense vivid green.
4. June grass, Kentucky Blue-grass (*Poa pratensis*), bright green.
5. Red Top (*Agrostis vulgaris*), pale green.
6. Squirel tail (*Hordeum pratense*), pale glaucous green.
7. *Eatonia Pennsylvanica*, bright yellow-green.
8. Wire grass, Canada Blue-grass (*Poa compressa*), dark purplish green.
9. Water Bent grass (*Agrostis stolonifera*), pale yellowish green.
10. Meadow Foxtail (*Alopecurus pratensis*), darker green than No. 5.
11. *Agrostis scabra*, glaucous variety, pale green (hair-like leaves).

The recognition of the colours and varying textures of grasses suggests many ornamental uses for these plants, such as the permanent marking out of tennis courts or other ornamental patterns on lawns.

CHESSE (*Bromus secalinus*, L).

In my annual report for 1891, I stated that at the request of one of my correspondents I had planted 100 grains each of Chesse seed and Fall wheat, with the purpose of proving that, in the first place, Chesse would come true from seed and produce seed from which Chesse and nothing else could be grown; and secondly, that no adverse treatment could produce a plant of Chesse from a grain of Fall wheat. As stated, 100 grains each of Chesse and Fall wheat were sown in September, and each grain was marked with a small picket. I had a witness present with me during the whole sowing operation, according to agreement. In addition to the 100 grains, a single row 8 feet long and 2 inches wide was also sown of each kind of seed.

Chesse.—The Chesse seed all germinated and appeared above the ground in the autumn of 1891. In the spring of 1892 it grew rapidly, as soon as the snow water, which lay on it for a fortnight, soaked away. The flowering panicles appeared May 27, and the seed was ripe by the end of July. The single row was cut down twice and continued throwing up flowering spikes until September.

Fall Wheat.—Most of the seed germinated and appeared above the ground in the autumn of 1891.

During the winter of 1891-92 the snow was shovelled off half the bed three times, so as to expose the young plants to the weather. In the spring, water lay on half this plot for a fortnight after the snow melted. In April half the single row was stamped down into the muddy ground with the heel of my boot and the other half was cut off close to the ground with shears. After this the plot was left alone.

RESULTS.

Chesse.—Nearly every grain grew and produced a strong plant of Chesse with many stems which bore an abundance of seed.

Fall Wheat.—Many plants of the 100 were drowned out by the water lying on them in spring; 42, however, grew and all produced Fall wheat. Of the single row,

both the plants which were stamped into the muddy soil and those which were cut down, grew equally well with the others and all produced Fall wheat.

To the above record I will add that of a single row of Chess sown in the spring of 1892, only one plant produced flowers that year. The plants went into the winter in healthy condition and will doubtless flower next spring.

In view of the above, I repeat again what I said last year: "There is only one remedy for Chess—to sow clean seed-wheat in clean land." If this be done there will be no trouble with Chess. Some thousands of farmers had this experiment brought under their notice during the season, and I trust that some of them may have been convinced that Chess cannot be grown from the seed of Fall wheat, whatever adverse circumstances it may pass through, any more than a rose can be grown from an onion seed. An illustration of the absurdity of the contention frequently put forth at Farmers' Institute Meetings, that Chess is a bastard grain and, therefore, cannot produce seed, is the fact that it is now largely grown in Oregon and Washington States as a hay grass. It is claimed to have a special value from growing on land-impregnated with alkali and unfit for the cultivation of Timothy. Mr. W. Tasker, of Ladner's Landing, B.C. writes. "I received some rye grass seed from Canada four years ago and found the following summer that it was nearly all Chess. I cut it for hay and the horses ate it well. Later, I was at Salem, Oregon, at the State Fair and saw the same grass among others labelled "Brome Grass." In speaking to the Manager of the Experimental Farm he told me that it made fair hay and if sown in the fall on land which turns white, a good crop of hay could be cut the following summer. It occurred to me that this meant alkali land. I afterwards learnt that it was a good deal cut and when Timothy was worth \$10 per ton, it was worth \$8. It is from three weeks to a month earlier than Timothy. When I came home from Oregon I gathered enough seed to sow half an acre. It yielded well and I harvested enough to sow nine acres of fallow with Chess and Red Top, and twenty acres of Chess and Timothy sown only on the surface, the other was harrowed in. The hay has the appearance of being good. I would not recommend sowing Chess where Timothy will do well, but in the North-west where there is Alkali in the soil it might be well to try it. Chess can be sown in the fall, a crop of hay reaped the following June, and the land then fallowed. I sow at the rate of 50 or 60 lbs., to the acre. Some complain of having Chess in their Timothy, I told one man he could get rid of it by cutting before the Chess had seeded when it will be done with, as it is only an annual; but if it is cut very early it will grow again from the roots, like oats cut for hay. Feeding off with sheep will finish it. When grown with Timothy, if left until the latter is ready, the Chess seed has fallen to the ground. Chess is hardier than Fall wheat. I had some last winter which was covered 8 inches deep with salt water for 3 days, and yet it came through all right. I never heard of Chess growing from Fall wheat or of killing pigs by the moon until I came to America."

The following letter containing much valuable information on this subject, has been received from Professor Moses Craig, Botanist of the Oregon State Agricultural College, in reply to an enquiry:—

"CORVALLIS, Oregon, 15th November, 1892.

"In reply to your letter of enquiry regarding the use of Cheat as a forage plant, I would say that in this (Benton) county, Chess (meaning mainly *Bromus secalinus*, L., though *B. racemosus* and *B. sterilis* are occasionally mixed with the above), grows well, and is considered by most farmers to be as good as Timothy, selling readily for the same price—\$12 a ton. This applies mainly to the hill regions, as in the valleys other grasses can be profitably grown.

"It endures the dry dusty summers much better than Timothy (*Phleum pratense*, L.), and is often sown in 'slashes' or freshly cleared and burned over land, where it makes a good stand. In the ranches of the Cascades when mixed with Wild Oats (*Avena fatua*, L.), it forms the entire food of cattle.

"Perhaps I can best answer your questions by giving the views of my correspondents:—

E. P. Williams, Lane County, says:—I sow Cheat for fodder, and find it excellent for all kinds of stock.

J. Bagley, Polk County, says:—Very good hay for cattle and sheep.

S. P. Reeder, Washington County, says:—Cheat grass makes good hay for horses or cattle.

C. D. Steen, Linn County, says:—Wild Oats and Cheat make good hay if cut green.

E. F. Messner, Josephine County, says:—Chess makes good hay for horses, sheep and cattle.

Wm. Miller, Lane County, says:—I feed Cheat to horses and cattle, and consider it a fair quality of hay.

J. D. Hayes, Josephine County, says:—Chess makes fair hay for cattle.

J. G. McCune, Linn County, says:—I consider Chess of great value as hay for horses and cattle.

Ernest Eggerth, Umatilla County, says:—Have used it to feed stock and horses. Cheat hay made when in bloom makes good hay, but not equal to Timothy.

G. R. Stephenson, Multnomah County, says:—I consider it of no value.

S. W. Miles, Polk County, says:—Wild Cheat not of as much value as the tame hay.

L. P. Williams, Clackamas County, says:—Wild Oats and Chess may have some value as feed if cut early enough, but as they open before Clover and Timothy, their value is limited."

"I think that Chess grows *much better* on 'white land' or soil impregnated with alkali than does timothy and other tame grasses. In regard to the time of sowing Cheat for pasture, some sow in the fall, giving a spring pasture, others sow in the spring for late summer pasturage. For hay the seed is usually sown in October.

Opinions differ regarding the value of Cheat, but in the mountains, foot-hills, and on white land, large quantities are annually saved for hay, and for these localities there is nothing to take its place except Wild Oats.

In the valleys no one raises it, as other grasses will give better returns there."

I have reproduced the above letter in full, as it contains much that may be of use to British Columbian and North-western farmers.